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ABSTRACT

This booklet contains the proceedings of a conference designed to elicit discussion, reactions, comments, and recommendations with respect to the value, desirability, significance, and budgetary problems involved in carrying out scientific research programs at comprehensive universities (those having either no Doctor of Philosophy (Ph.D.) programs or a very limited one at best). The first part summarizes three breakout sessions focused on: (1) integrating research and teaching; (2) the long-term benefits of research at comprehensive universities; and (3) external and internal support for research at comprehensive universities. The next part summarizes six speeches related to the breakout sessions. The last section presents abstracts of 14 papers describing case studies of each comprehensive university. (YP)

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PROCEEDINGS

Conference on Science Research in the Comprehensive University

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Marriott Hotel
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1988

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INTRODUCTION

The conference, organized by the Office of the Chancellor, The California State University, and attended by some 150 administrators and senior faculty from 27 different states, was designed to elicit discussion, reactions, comments, and recommendations with respect to the value, desirability, significance, and budgetary problems involved in carrying out scientific research programs at comprehensive universities (those having either no Ph.D. program or a very limited one at best).

To this end, a number of distinguished speakers, including scientists and administrators familiar with problems inherent in establishing and supporting active research programs at comprehensive universities, addressed the conference during three separate plenary sessions. Each plenary session was followed by a "breakout" session, during which each conference member was assigned to one of nine different groups to facilitate discussion and comment about all the issues that arose from the preceding plenary session. Each group selected a recorder to prepare a written summary of the group's collective responses to a set of questions posed by the conference organizers that related to the specific topics raised at each plenary session.

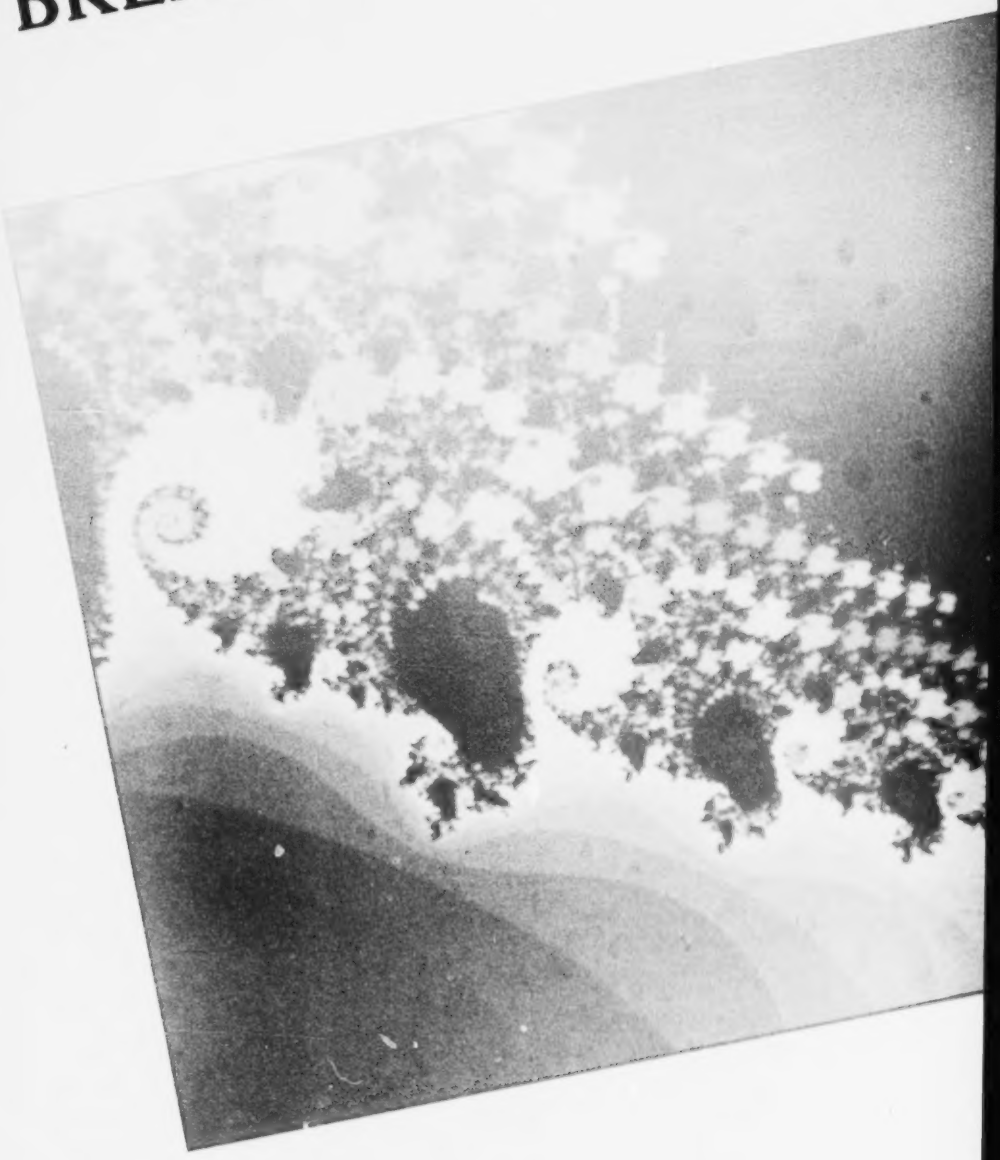
The main topic for consideration at Breakout Session I was "Integrating Research and Teaching." After the group discussions, responses to the specific Session I questions were prepared by each of the group recorders. Later, the essential features of the nine separate reports were condensed to produce a single overall Session I report.

This procedure was repeated after each of the two remaining plenary sessions. Breakout Session II focused primarily on "The Long-term Benefits of Research at Comprehensive Universities to the Institution, the Community, and the Nation." Breakout Session III was concerned with "External and Internal Support for Research at Comprehensive Universities."

For a second and third time, reports were prepared describing the reactions of each group to the questions that were asked at Sessions II and III. Then the collective wisdom of the entire conference, which was first distributed among 27 separate group reports, was condensed into three individual session reports.

The proceedings presented here represent the final stage of this long process of condensation in which information derived from the reports of Sessions I, II, and III was gathered into this final report of the Proceedings of the Conference. We trust that it does not seriously distort any of the conclusions and recommendations presented by the many concerned scientists and administrators who so cheerfully contributed their time and energy to assure the success of this conference.

Summaries of BREAKOUT SESSIONS



BREAKOUT SESSION I

After hearing addresses by David E. Drew, whose topic was "Strengthening Academic Science," and Philip H. Abelson, who spoke on "Improving Science at the Comprehensive Universities," the participants went to their assigned group meeting rooms to start the first of the three breakout sessions. Each group was asked to discuss and comment on the three following subjects:

1. Define science teaching and research, and characterize their relationships with respect to comprehensive universities.

2. Dr. Abelson has stated that scientists have failed to educate the public with regard to the value and role of research by university faculty. As a result, many people think that research activity and good teaching are not compatible. Comment on the validity of this view with regard to the comprehensive university, as understood by faculty and students.

3. How did the presentations of Dr. Drew and Dr. Abelson address this view?

The reports follow.

1. However research is defined (and it is difficult to reach a consensus regarding any definition, even when research in the arts or humanities is excluded), each group, with little or no dissension, agreed that research in a comprehensive university differs in no essential way from research done anywhere else. However, the size of most research projects, the level of support for research (especially basic research), as well as the time available for instructors to engage in research, are clearly quite limited in most comprehensive universities.

   Further, as some observed, in competition with grant applicants from major research-oriented institutions, first-time grant applicants from comprehensive universities have a poor record of success. Often their projects have little merit and are supported by neither prior work showing the projects' feasibility nor reprints of sole-author publications showing the applicants' competence in independent research.

   These difficulties in obtaining initial research support, which are related more to inexperience than to lack of ability, have surely deterred research activity in

comprehensive universities. However, the rare grant applicants who do have early success in obtaining grant support are quite likely to receive continuing support. For example, many conference members know colleagues who have received more than one federal research grant.

Although agreeing to a definition of scientific research that is acceptable to all appears to be nearly impossible, most participants seem to regret that opportunities for faculty research are so limited at comprehensive universities. On the other hand, the group reports indicated that research activity and support were slowly, but surely, improving on at least some campuses.

2. In their discussions, the nine different groups drew many and varied conclusions about the quality of scientific research in comprehensive universities. However, little or no disagreement was seen regarding the value of research, particularly with respect to its role in maintaining teaching effectiveness.

   Research not only requires teachers to keep up-to-date on all of the important developments in their areas of science, it also nurtures an enthusiasm for their subjects and arouses excitement for science, without which teachers cannot transmit excitement and enthusiasm to their students. Yet, this ability is of great importance in persuading serious students to consider science as a life-long career.

   Furthermore, students get exposed to the current state of knowledge in the field, not to the lore of a generation ago. Also, undergraduate students can be introduced to actual research equipment and methodology and become involved (to some degree) in real experiments, as well as in solving actual research problems. Best of all, by being active in research, science teachers present an effective role model for students who may be considering science as a career. Also, families of students who have been taught by such teachers will hear first-hand the true facts regarding the benefits of having science teachers at comprehensive universities who are involved in research, especially when they compare their children's experiences with those of their children's companions whose science instructors may not have been inside a laboratory since their graduation and whose lectures were dry, out-of-date, dull and uninspiring.

3. On the last question, most groups had little or nothing to say. One group, in fact, stated that they could not identify any way in which either of the two presentations addressed the issues at hand.

In conclusion, the general feeling that seemed to prevail in the various groups was that differences, if any, between teaching and research in comprehensive and research-oriented universities lie mainly in the involvement of undergraduate students as an important component of research activity in the comprehensive university. Furthermore, research in such a university serves to support the teaching function. To be sure, emphasis is put on teaching, not research, at the comprehensive university, but suggestions that teaching and research are in conflict at any institution must be rejected out of hand. Research complements and improves teaching; in fact, teaching would greatly benefit if some degree of research activity were required of all science teachers at comprehensive universities.

Isn't it paradoxical that a greater involvement in teaching, particularly at the undergraduate level, would be equally beneficial to both students and scientists at any research-oriented university, but few authorities seem to be concerned about that!

BREAKOUT SESSION II

When the conference members reassembled, George E. Brown, Jr., Congressman, U.S. House of Representatives (D, 36th District, California), spoke on the "Long-term Benefits of Research in Comprehensive Universities to the Institution and the Nation." Following his address, the members returned to the same nine discussion groups as before for Breakout Session II. At this session, only two subjects for discussion were presented for consideration:

1. What do you think are the long-term benefits of research to your institution and to the community at large?

2. What do you think are the long-term benefits of research at the comprehensive university to each of the following: manpower needs, graduate education, and underrepresented minority and women access?

The mass of notes from each of the discussion groups was condensed into a Session II report, a summary of which follows.

1. In considering the benefits of research at a comprehensive university to the institution itself, the groups discussed a number of possibilities, as well as some that actually came up, either directly or indirectly, at the first session. Most conference members clearly supported the view that faculty involvement in research activity improves teaching. Thus, an institution that provides research opportunities for its faculty will develop a well-deserved reputation for good teaching. That, in turn, will not only attract better students to the institution, but will make it easier to recruit the best applicants for faculty positions. Also, it will stimulate any faculty members who do not engage in research to "get with it." Overall, improved research climates lead to improved teaching as well as to enhanced morale. Last, but not least, that leads to a happier and more enthusiastic student body, which is surely one of the more important effects of encouraging faculty research at a comprehensive university that is blessed with enlightened administration.

   In time, as the reputation of an institution for good research becomes recognized by alumni, local business, and community leaders, the institution will find it easier to obtain financial support for its fellowship programs, athletic scholarships, student loans, and building funds, as well as for many other projects that are important to the complete mission of the institution, but are underfunded, or not funded at all, in its regular budget.

Thus, the general conclusion of the group members at this session seemed to be that research at comprehensive universities is not simply desirable, but vitally important for their ultimate success and long-time survival as effective teaching institutions. In this context, good research gives rise to the same kind of beneficial effect on university welfare as does a good athletic program. Therefore, a good research program deserves the same high priority as does a good athletic program.

The benefits of research at a comprehensive university to the community at large can be characterized as follows: It adds to the general supply of experienced scientists. At present, a great many newly graduated Ph.D.'s, even those with postdoctoral experience, find it difficult to obtain faculty positions at any large, research-oriented university. However, job opportunities at a comprehensive university are much more numerous. When such already motivated, potentially productive research scientists are hired, but are given no opportunity as new junior faculty members to do research, their talents are wasted and the morale of the entire group is depressed. They, more than older, tenured, full professors, should be given preferential treatment by the institution and allowed released time to become active in research.

The increased research benefits the young researchers, students, the institution, and industry, who may realize that the local university has trained personnel who can undertake subsidized projects. Even more distant institutions might find it worthwhile to contract for young scientists such as these to work on research projects for them.

This pleasant scenario, however, will not come to pass until research becomes a regular part of the daily routine of a great many comprehensive university teachers. (Older, tenured science teachers are not likely to modify their habits. If they never have been involved in research, they are not likely to start now. Perhaps, however, they could be persuaded (required?) to teach an extra section or two on occasion in order to provide the released time needed by other faculty members who are active in research and are better teachers because of it.)

2. *Manpower Needs*: Research activity at the comprehensive university, in much the same way as described above, reduces the national need for science manpower by providing the trained personnel needed by government and other agencies that are now unable to fill their slots entirely with graduates of research-oriented institutions.

Nonetheless, the very scientists they need are available because they had been employed by comprehensive universities that allowed them to keep their skills honed.

There are surely many other young, capable scientists who are now working at nontechnical jobs for which they are overqualified and underappreciated. Here is another potential source of research manpower that could be exploited if either the states or the federal government would assist comprehensive universities to hire such people by underwriting most or all of their salaries. This would simultaneously make it possible to reduce the teaching load of comprehensive university faculty and to return productive, but currently wasted, scientists to the manpower pool.

Graduate Education: The most obvious benefit of having research programs at a comprehensive university is the simultaneous need to establish master's programs. Research in comprehensive universities, as anywhere else, requires assistants, but in view of the scarcity of research funds at comprehensive universities, assistance must be as inexpensive as possible, i.e., graduate students. Without any graduate programs, there will be no graduate students, hence no research.

The mere fact that research activity exists at a comprehensive university ensures that graduate education will be established. That, in turn, spells a research-oriented faculty, better teaching, and a well-trained, stimulated, eager student body that is more likely to continue graduate education at some other institution in order to obtain a Ph.D. Further, teachers who are active in research do the best job of stimulating undergraduate students to enter graduate school rather than quit school altogether. Some of these "recruited" graduate students may go on to become researchers themselves and, in time, perhaps, will end up at a comprehensive university, only to start the cycle all over again.

Underrepresented Minority and Women Access: The comprehensive university must be alert to the benefits of assuring access for women and minorities to its research programs. At the top, talented minority and women students are generally lured by the high salaries available in many professional careers. They often avoid, insofar as they can, taking "hard" science courses as undergraduates. However, the Minority Biomedical Research Support Program, for example, can provide stipends for students and faculty and funds for special pieces of equipment. Lures like these do attract good students, many of whom complete the course and go on to become health

professionals. Further, the presence of minority or women scientists on the faculty of a comprehensive university ensures the presence of badly needed role models for students, especially where there are few such professional people in the surrounding community.

Because of their location, their low fees, and the availability of Educational Opportunity Program assistance, comprehensive universities are able to attract many of the best minority and women students to their campuses. Students usually feel that the comprehensive university cares about them, that the teachers are approachable, and that many opportunities to become involved in research projects are there for the asking.

In the long run, strong and positive interactions between minority and women students, other students, faculty, staff, and everyone else on campus will show the way, let us hope, to the end of prejudice and discrimination among all citizens.

BREAKOUT SESSION III

The third and last breakout session was preceded by two addresses. The first was "Research: New Opportunities to Excel" by Dr. W. Ann Reynolds, Chancellor, The California State University; the second, "External and Internal Support for Research in Comprehensive Universities" by Dr. John H. Moore, Deputy Director, National Science Foundation. After the addresses, the discussion groups reassembled in their meeting rooms for Breakout Session III to discuss and comment on the issues raised by the two talks.

For this session, the discussion subjects were:

1. How would you enhance research in comprehensive universities with existing institutional support?

2. How would you enhance research in comprehensive universities with new institutional initiatives?

3. Make some recommendations on how we can change the attitudes and perceptions of funding agencies, state and federal legislatures, and private sector groups so as to enhance and support research in comprehensive universities.

The reports follow.

1. Undoubtedly, more could be done to enhance research in comprehensive universities within current levels of institutional support. Some of the more effective approaches are listed. If not already in existence, small, competitive in-house research grants can be instituted. Grants of this kind can be funded with money derived from the indirect costs generated by already existing grants or, possibly, with profits from the operation of campus foundations. Where such programs exist, increased research productivity is observed. With rather small amounts of money, an essential student research assistant can be hired (during the summer, at least), or a vital piece of equipment can be bought. Travel to a nearby research center for consultation about new techniques becomes possible but, more important, a stimulating sense of accomplishment and self-worth is aroused.

   The result of all this is to provide a greatly needed boost of morale, as well as an increase in research activity on campus. This type of seed money may well make it possible to carry out preliminary studies needed to

demonstrate the feasibility of a project without which no grant proposal to an outside funding agency will ever be successful.

A Research Projects Office can be most useful in identifying sources of grant funds, obtaining application forms, providing assistance for typing applications, and even holding workshops in "grantsmanship." If this type of support is not available on campus, no time should be wasted before setting up an effective research office supported by the regular budget.

Another inexpensive approach to stimulating research is to sponsor annual recognition programs that provide positive rewards (preferably released time for research) to one or more tenured faculty scientists for outstanding research accomplishment during the year. Likewise, appropriate recognition for, say, the best scientific textbook or monograph published during the year might stir colleagues into increasing their scientific activity. Programs like these attract favorable comment about the campus and provide well-deserved publicity for its scientists.

Often faculty can carry out modest research programs using supplies and equipment purchased with regularly budgeted departmental operating funds that are provided to make it possible for undergraduate or graduate students to carry out independent research projects. The institution should encourage, not discourage, such activity by recognizing it as educationally desirable for both the faculty member and the students, thus deserving of released time for the scientist. Moreover, increased operating budgets should be provided for departments having a significant amount of research that not only was carried out under these circumstances, but also led to publication.

2. As should be obvious, successful efforts to fund a significant enhancement of research at comprehensive universities will, sooner or later, require more support than can be provided by the institution solely from its regular budget. Without more funds from somewhere, there never will be much more research conducted at comprehensive universities than takes place at present.

   The obvious source of supplementary research funds are federal granting agencies, such as the National Science Foundation, the National Institutes of Health, the Department of Agriculture, and a few other specialized agencies. Yet, as noted above, grant applications from

comprehensive university science faculty fare quite poorly. This problem requires dedicated action to overcome.

Over the years, grant agency personnel have reviewed thousands of grant proposals. Too frequently those that originated from comprehensive universities were evaluated as being less meritorious than grant requests from research universities. Even so, early on at the National Science Foundation, for example, proposals from small institutions with little research activity were given "brownie points," so to speak, and often small seed-money grants were awarded.

Yet, now the old prejudice must have been rejuvenated. Research proposals from most comprehensive universities seem to come already prejudged. These institutions are considered to have rather poorly trained, unsophisticated personnel, inadequate and outdated facilities, allow insufficient time for the faculty to carry out research projects, and provide no research support for investigators. Even though grant administrators will certainly deny that such a prejudice still exists, few research applications from comprehensive universities, regardless of merit, seem to win approval in competition with those from research-oriented universities.

This problem must be overcome if ever research is going to flourish at comprehensive universities. This poor image of the quality of research at these institutions must change. First, better applications must be prepared. In order for this to occur, all grant applications, before their submission, must pass a rigorous screening by a panel of experienced senior faculty who have held research grants awarded in competition. Next, all new science faculty must be selected from among candidates who graduated from good research schools and have postdoctoral experience, i.e., who have good research projects in mind. Then, they must be provided with appropriately equipped laboratory space and have a teaching schedule compatible with research. With such a program in existence, and with the recognition that research must receive a high priority among administrators, the quality of research at comprehensive universities will show marked improvement, as will the frequency of grant awards.

3. These improvements will come to pass only following vigorous and successful campaigns led by the president himself to improve the image of research at comprehensive universities in the eyes of grant administrators, alumni, executives, community leaders,

and the institutions' own governing boards or, in the case of state-supported universities, the state Legislature and the Governor. Second, the popular idea that teaching and research are incompatible must be replaced once and for all by its very antithesis: teaching and research are not only compatible, but they exist in a symbiotic relationship such that each activity grows and prospers from the other, to the benefit of both student and teacher.

In the case of university systems such as The California State University, the Chancellor and Trustees, joined by all of the individual university presidents, must spearhead the drive for the enhancement of research at the various comprehensive universities in the system and lead the presentations to the Governor and legislators for the additional funds that will be needed.

With widespread community, state, and federal support, we can look forward to the long-desired improvements in the academic performance of our comprehensive universities. No university should be put in a position where it cannot fulfill its mission as a true university. Teaching institutions with no effective research programs are not truly universities. They are, in fact, simply teaching institutions. A university by definition not only should acquire knowledge and understanding through research, but, in equal measure, its complete mission includes disseminating that knowledge and understanding by teaching.

Besides the drive to change the public image regarding the importance of the interaction between research and teaching, the drive to gain funds in order to enhance and support research at comprehensive universities must be expanded to include every possible source of money, not just federal agencies, governing boards, and legislatures. Organized fund drives led by experienced and successful solicitors must be undertaken to approach alumni, private philanthropists, foundations, and all possible friends of the university. Using persuasive material that had to be prepared for the drive to obtain support for the enhancement research at comprehensive universities, they should be able to raise significant sums, not only for research, but also for endowments and other important university needs.

In due course, the time will arrive when all comprehensive universities have achieved the status they deserve. This will occur when they become accepted as equals into the community of true universities, and when they are recognized by all as playing a significant role in

scientific research and many other forms of scholarly activity, not just teaching. No longer will they have to bear that rather disparaging and meaningless epithet, "comprehensive." Either they are truly universities, or they are not universities at all, just teaching colleges as, indeed, most once were.

SUMMARY

The three-day conference, attended by some 150 participants, was an outstanding success. Extended and enlightened discussion followed a series of addresses given by noted authorities on problems associated with enhancing and supporting scientific research in comprehensive universities. The discussions led to many useful suggestions and conclusions relating to the benefits of such research to the universities and their students, as well as to their faculty and the surrounding community. Also, various ways of obtaining support for an enhanced research program arose from the discussions.

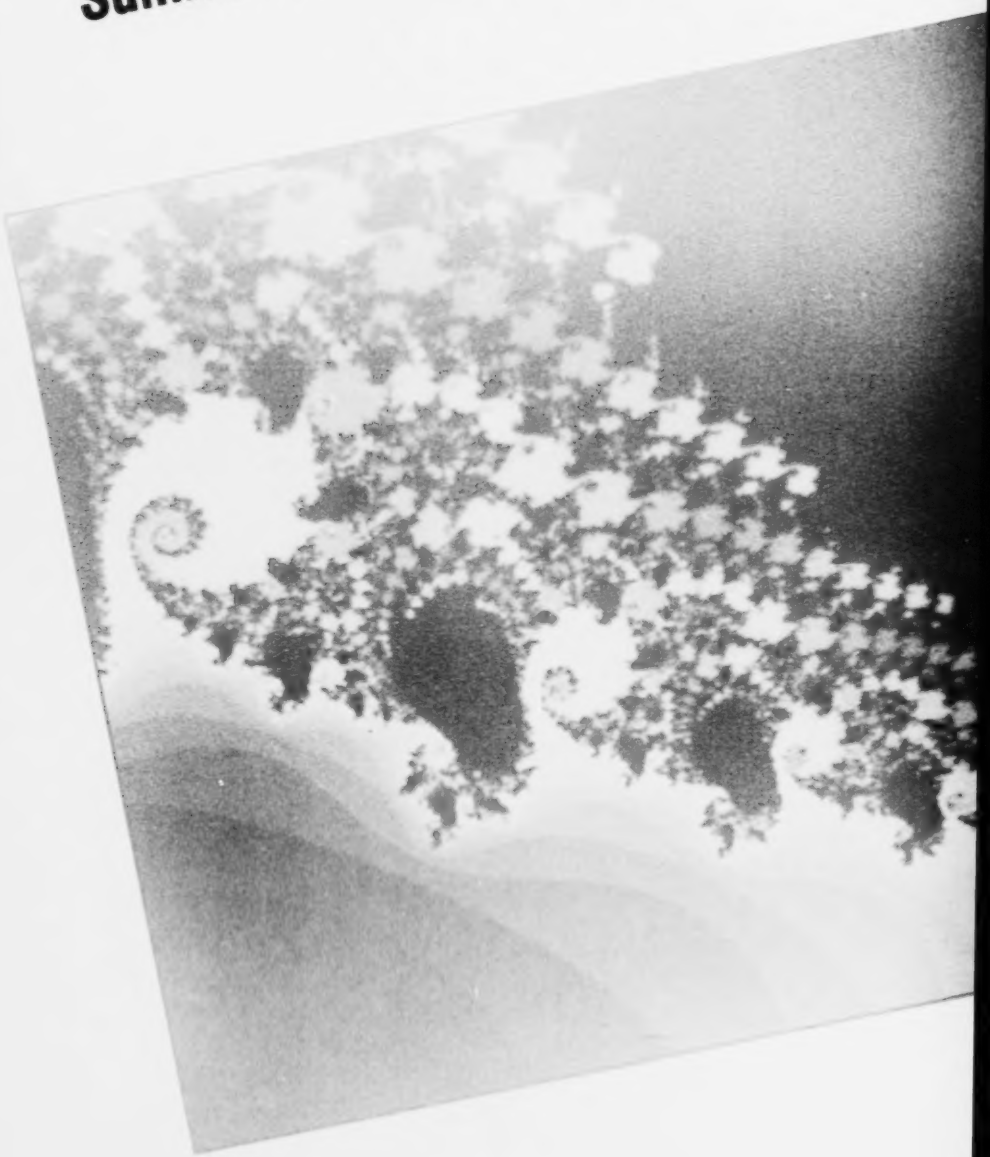
Important conclusions arising from the conference were:

1. Teaching and research at any institution interact in a symbiotic way such that research activity makes the researcher a better teacher, and students benefit from having a more knowledgeable, up-to-date, stimulating, and enthusiastic instructor.

2. Research programs at comprehensive universities provide benefits to the institution, the community, the state, and even the nation as a result of the improved teaching that derives from research activity, the availability of trained science faculty to undertake research projects for industry, and being able to provide the science manpower needed by state and federal agencies that no longer find it possible to fill their open positions for scientists solely from among the graduates of the better-known, research-oriented universities.

3. Successful drives, spearheaded by presidents and system leaders, must be mounted, first, to counteract and dispel the widely held notion that teaching and research are incompatible, i.e., that comprehensive universities should be restricted to teaching, leaving research to others. As long as this concept prevails, particularly at research-oriented universities and government-granting agencies, such as the National Science Foundation and the National Institutes of Health, among others, scientific research will neither prosper nor find support at comprehensive universities. Second, an equally important but different drive directed at both private and public sectors has to be mounted in order to obtain funds to support any enhanced research activity at comprehensive universities. The success of this drive is essential to the continued existence of comprehensive universities as effective teaching institutions. With no ongoing research programs, these universities will, in due course, revert simply to being teaching colleges.

Summaries of SPEECHES



THE HONORABLE GEORGE E. BROWN, JR.

36th District, California
U.S. House of Representatives

Title: ***Long-Term Benefits of Research in Comprehensive Universities to the Institution and the Nation***

According to Congressman Brown, research plays an important role in achieving educational excellence and in provoking curiosity and discovery. He said, "All parts of the educational system should not have identical roles, but research should not be confined to the research universities. Research is an integral part of education. Mere assimilation from authorities is sterile. Education that does not build on natural curiosity can never be education of the highest kind."

Without attempting to duplicate the work of major research universities, Brown felt that comprehensive universities should be involved in what he called "little science," which can provide a fruitful and exciting educational experience.

A particularly important task for the comprehensive universities should be to develop, encourage and support a compulsion for excellence, and to instill this notion in the hearts of future teachers, the majority of whom are educated at comprehensive universities.

In setting research priorities, Brown felt that the first priority for research at comprehensive universities should be research on education itself. A second priority would be research focused on the community of which the university is a part.

DR. DAVID ELI DREW

Professor
Claremont Graduate School

Keynote Address: ***Strengthening Academic Science***

Because of the tightening of the academic job market in the past decade, faculty trained for research in the top research universities are dispersed amongst all types of institutions, notably comprehensive universities. This, according to Drew, provides comprehensive universities with a rare opportunity to engage in an increased level of research. To do this, however, comprehensive universities must find a way to attract federal funds.

Drew stated that comprehensive universities can get government funds without attempting to become research centers. One way that he proposed was for universities to cooperate with state leaders to emphasize research where obvious institutional strengths exist or where the state has needs for basic and applied research. But when doing that, Drew felt it was important to articulate how the research promoted the institutional commitment to teaching.

Drew felt that nurturing the research efforts of faculty was particularly important, since early research success can set a pattern for continued productivity.

Drew's research has concluded that the single key ingredient that determines success in developing a strong science capability is committed and strong leadership.

DR. JOHN H. MOORE
Deputy Director
National Science Foundation

Title: ***External and Internal Support for Research in Comprehensive Universities***

New knowledge and technological innovation play a critical role in determining our ability to compete in the modern world, according to Dr. Moore. Over the last two decades, the dominant position of the United States in world markets has eroded. Now, American products must compete with goods from abroad even in our own domestic markets.

Moore said, while leading the world in total R&D investment, the lead we enjoyed over our competitors has narrowed sharply. Also, while they have significantly increased their technical labor force, current trends indicate that our production of technical degrees, as a proportion of total degrees, is dropping at all levels. A declining population base will further decrease the availability of technical talent unless current rates of degree production improve.

He felt universities were the primary sources of new knowledge and the training ground for scientists and engineers and that our system of higher education, with its unique combination of research and education, the best in the world. But it faces major challenges resulting from the escalating cost and complexity of research. To meet these challenges, Moore said we must invest adequately in our research enterprise, encourage cooperation and multidisciplinary research, and provide a supportive institutional framework through new approaches such as major multidisciplinary research centers. He concluded, saying we must make the necessary investment in our human resource base.

DR. W. ANN REYNOLDS
Chancellor
The California State University

Title: ***Research: New Opportunities to Excel***

Chancellor Reynolds called for college administrators, state legislators, foundations and the American public to develop a new vision of the role that research should play at comprehensive universities.

Decrying the dwindling number of American scientists, Reynolds predicted that bringing research into the classrooms of comprehensive universities could do more to enhance the teaching of science than any other single step, because research keeps professors on the cutting edge of their disciplines while at the same time exciting the imagination of students.

Unless research is promoted at comprehensive universities, our nation, according to Reynolds, is wasting the skills of thousands of scientists now employed at comprehensive universities who were trained as researchers but who are presently denied the opportunity to utilize and enhance their research skills. Better utilizing these "forgotten scientists" would enrich the academic environment of campuses from coast to coast.

DR. JOHN P. SCHAEFER

President
Research Corporation

Title: ***Sleeping Giants of Science Education***

Dr. Schaefer said the United States has been losing its competitiveness. He feels a university education is a very important factor in maintaining American competitiveness.

He described fifty liberal arts colleges who in 1975 graduated 7,000 majors in math and science and ten years later graduated 7,165 students. He compared this with the top twenty premier public and private research universities who graduated 7,603 majors in math and science in 1975 and only 4,685 in 1985 — down nearly 40%. He noted that the liberal arts colleges who are dedicated to undergraduate education have maintained and slightly increased their output of science majors. Certainly they are doing a much better job of attracting and graduating science majors than research institutions where teaching has become of secondary importance. Of these majors in liberal arts colleges, 50-70% go on to graduate and professional schools.

Because of their strong belief in research, the Research Corporation has played a major role in revitalizing science departments. They brought money and advice and encouragement to these schools. They initiated a project to assist young faculty members to start their research programs.

The Research Corporation found high school teachers not well prepared in science and decided to involve high school teachers in classes with university faculty during the year and especially during the summer. They established programs in Arizona, New Mexico and California, and thirty two-year programs were awarded this year. This project has rekindled teachers interest in research.

Four-year public colleges represent an untapped resource and have an opportunity to make a niche in the university science establishment. Dr. Schaefer stated that the comprehensive university has the opportunity to influence the importance of research.

DR. ROSALYN YALOW
Nobel Laureate

Title: ***Historical Development of a Research Career***

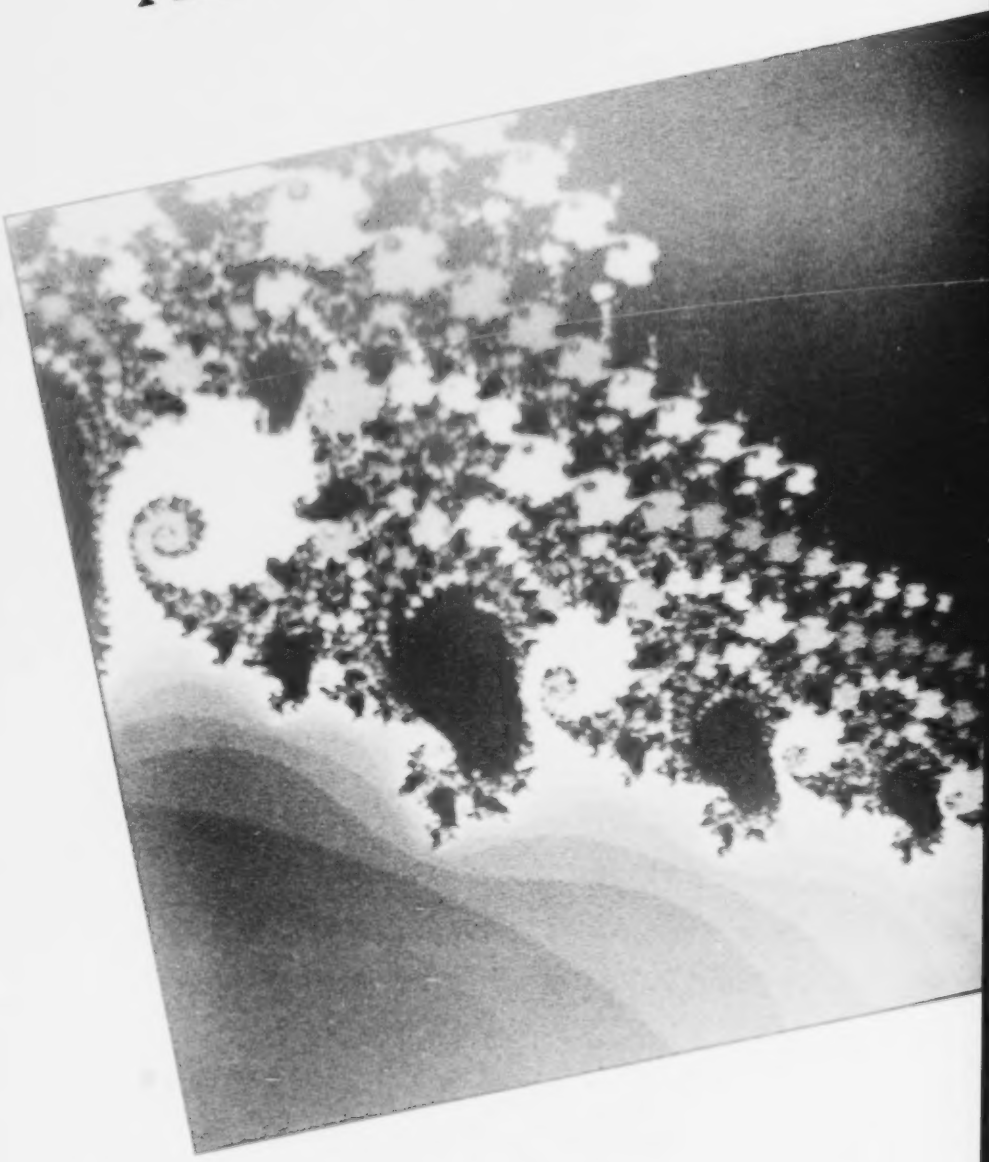
Dr. Yalow gave a brief history of her undergraduate years at Hunter College and of those professors who influenced her career. She received her Ph.D. in Physics from the University of Illinois and, following the war, returned to Hunter to teach. Though Dr. Yalow greatly enjoyed teaching, she felt her preference was for research and left teaching with great regret.

She described the roles important in a comprehensive university: Those who think about teaching, and editing and writing books; those who give special attention to students; those whose basic interest is in research; and those who carry on limited research using undergraduate and graduate students as helpers.

Dr. Yalow stated her preference for a small lab where she could work closely with the undergraduate and graduate students. She stressed the importance of treating these young people as professionals rather than as technicians.

She felt the purpose of research in comprehensive universities is not to enhance the research stature of the professor, but the basic premise is to teach the young people how to think and help them develop into scientists. She believes that teachers make the difference and personal interaction is most important.

ABSTRACTS



LYNN R. SOUSA
Ball State University
Muncie, Indiana

A Home Grown Chemistry Department Summer Research Program

For the past thirteen years the Chemistry Department at Ball State University has nurtured a group approach to providing research experience for undergraduate chemistry and science majors.

Motivating factors include: 1) the belief that a science student's education should include the performance of original experiments which are part of a sound research program; 2) the belief that research keeps faculty alive and current in their fields; 3) the recognition that it is extremely difficult for an individual researcher to maintain the consistent external and internal grant support that is needed for research continuity; and 4) the realization that it takes "gumption" to stay active, and a group's supply exceeds the sum of its parts.

Key features of the program are: 1) a pooling of resources for the payment of modest stipends to the summer research students (sources have included grants to individuals from Ball State University, ACS-PRF, NSF, NIH (AREA), and general support from the Dow Chemical Co. Foundation, Indiana-American Water Co., the Provost, the Chemistry Department, and others); 2) faculty members directing student research without receiving salary for their efforts; 3) weekly group meetings in which students discuss their work; 4) the expectation that results will be presented by students at statewide scientific meetings and eventually published in refereed journals; and 5) former students and their employers who testify that the research experience has been extremely valuable.

J. BAIRD
Bloomsburg University
Bloomsburg, Pennsylvania

College Science Research for Late Bloomers

Much opportunity for undergraduate research has been provided by honors programs. Typically, these enriched curriculums are intended for the bright high school graduate who competitively lands a four-year scholarship. The student who gets serious about study and future plans later in college is often denied these opportunities.

At Bloomsburg, honors has been divided into a 2 + 2 arrangement. The first two years are intended for the traditional bright "Scholars" student, a general education interdisciplinary curriculum with team-taught courses and other special opportunities. The latter two years constitute a separate "Honors" program which is discipline-oriented, and is also open to those late bloomers who have discovered an aptitude for science during their first two years. Acceptance is based on GPA, faculty sponsorship, and a preliminary topic proposal.

Honors juniors take a seminar on methodology and interdisciplinary topics, and then follow with two semesters of independent study with a faculty member of their choice. A capstone paper session during the last semester provides a chance to share outcomes. The project has created a research opportunity for students who realize their potential for scientific excellence after high school.

ROBERT A. LUCAS
California Polytechnic State University, San Luis Obispo
San Luis Obispo, California

Student Centered Research at Cal Poly

At California Polytechnic State University, San Luis Obispo, applied research is often part of the regular course work of undergraduates. Examples occur in most curriculums. In computer science, students enrolled in an advanced course called a practicum study discuss an actual problem provided by a host industry and write a report as a class project. In senior level political science courses, students analyze the problems of a local governmental agency identified through the Center for Practical Politics and discuss their findings with agency people. In agricultural engineering, senior seminars focus on designing equipment to meet the needs of modern farming. Studies sometimes involve a contract or grant with the sponsor, which might be an industry, a business, a grade association or a governmental agency.

All undergraduates are required to complete a senior project before graduation. These projects are conducted under faculty supervision and involve the generation of new knowledge, the replication of important and significant studies, or the application of knowledge to a new situation. A report is filed in the department and in the university library, and summarizes the results of the study or experiment. The problems which form the basis of the study or experiment are directly related to the student's intended field of employment. Sometimes senior projects are supported by grants or gifts of materials and supplies.

The characteristics of student-centered research at Cal Poly are the following: it involves undergraduates; it focuses on the teaching-learning process for the student; it studies topics of state and local concern; it is less product oriented than routine consulting and often of a general enough nature to be supported by trade associations; and it produces results that are publishable.

ELAINE G. WANGBERG
California State University, Chico
Chico, California

Status of and Innovative Solutions to Encourage Research and Scholarship in the Comprehensive University

A survey presented at this year's annual meeting of the Council of Graduate Schools entitled "Encouraging Research and Scholarship Among Faculty in Masters Only Institutions," will be shared. Innovative solutions for encouraging research and scholarship will then be outlined, including: institutional commitment; linking research with teaching; reduced teaching loads; provision of graduate assistants; sponsored project support office; incentive programs; funding searches; grant bulletins; research coordinators within colleges; special agency initiatives for undergraduate institutions (NSF/REU, RUI, and ILI); AASCU and OFP support; and the use of technology.

RICHARD TULLIS, KENNETH REBMAN and MAURICE DANCE
California State University, Hayward
Hayward, California

Grant Writing Incentive Program

In 1983 the University implemented the Grant Writing Incentive Program (GWIP). It was designed to foster and stimulate campus research by providing monetary incentive to faculty to increase the submission of grant proposals from this campus to various granting agencies. By increasing grant proposal submissions it was hoped that there would be a concomitant increase in awards. This appears to be the case. The GWIP provides funds to full-time tenure track faculty who are actively engaged in preparing and writing grant proposals for research, or projects, of a significant nature. The GWIP award to a faculty member does not exceed $3,000; the actual amount that is awarded is determined by the indirect cost payback to the university as proposed by the submitted grant. If there is no indirect cost payback, the award will be minimal. The GWIP, by using the indirect cost paybacks from awarded grants, essentially pays for itself. The University Committee on Research and the CSUH Foundation administer the GWIP.

DENNIS FALUK
Central Missouri State University
Warrensburg, Missouri

The CMSU Chemistry Department began an undergraduate research program for all majors, effective during the 1986-87 academic year. Perhaps the major problems are proper structuring of the curriculum to assure students are qualified to complete meaningful research projects and scheduling courses to provide time for effective faculty advisement.

During the sophomore year, chemistry majors begin an integrated series of "hands-on" instrumental experiments involving modern spectroscopic and separation techniques, thus enhancing the qualifications and potential of students for independent projects. A chemical literature and communications course was added and other parts of the curriculum revised to increase the effectiveness of the research program.

The department attempts to develop class schedules in a manner that provides credit for faculty advisement and provides periodic relief for study and preparation.

CHARLES BROWN and CARL ADLER
East Carolina University
Greenville, North Carolina

In response to the difficulty a comprehensive university has in obtaining funding from the federal level for basic science research, both the Geology and Physics Departments have developed applied programs. These programs have attracted support from nontraditional sources such as industry. Frequently, this has been used to involve students in research projects. The teleological character of this research is attractive to students and is an excellent way to acquaint them with the structure of research as well as to lead them to a better understanding of their subject. One particularly successful project involved an entire undergraduate geology class in field research of significant economic and educational merit. The Physics Department, for its part, has involved students in industry-sponsored research projects, ranging from a thermodynamic study of the tobacco preparation process, which was sponsored by a major tobacco firm, to a biophysical study of drug encapsulation delivery systems sponsored by a major pharmaceutical firm.

RICHARD A. CROFTS
East Tennessee State University
Johnson City, Tennessee

Like other universities, ETSU has been challenged by the cost of providing educational and research experiences using state-of-the-art computer technology and software. At the same time, local and regional government agencies are hard pressed to provide sufficient trained personnel to meet their steadily growing responsibilities (some now delegated to them by the federal government) in planning and development. In 1985, the city of Johnson City acquired a computerized geographic information system using powerful AUTOGIS software, which it was not feasible for the university to purchase. The city and the university jointly established a Geographic Information System Research Center, housed in city offices. The university added faculty expertise and trained resourceful students to the computer resources provided by the city. The students have gained a laboratory for field instruction and research experiences which would not otherwise have been available to them. A course in GIS is taught on-site by the director of the city's system and incorporated into the university's program in urban and regional planning. Students have produced research studies analyzing problems of the city and region.

ERNEST H. GILMOUR and ALLAN SCHOLZ
Eastern Washington University
Cheney, Washington

State university governing boards and coordinating councils responsible for establishing institutional mission statements have attempted to confine the role of comprehensive universities to a narrow teaching role. Our view of the comprehensive university includes a mission that balances teaching and research in the area of science. Ideally the research activities should support the teaching activities and produce a mutually beneficial learning experience for both professor and student. This view recognizes the legitimate need to support research at the comprehensive university.

For example, EWU is heavily involved in the Columbia River Basin fish and wildlife program, and a number of undergraduate and graduate students, including six Native Americans, have been working on grant funded research in fisheries. Participation in research activities provides incentive for the Native American students to excel in their classroom studies, and the senior students serve as role models for the beginning students. Eastern's unique role in Columbia River Basin research and education of Native Americans is due to the university's location. Native American students, in particular, prefer to attend universities in their geographical region. We believe that it is essential that comprehensive universities like Eastern be given the responsibility to serve these regional research and educational needs.

WILLIAM DAEHLING
Lewis-Clark State College
Lewiston, Idaho

In 1985, Lewis-Clark State College (Idaho) established an annual student research poster exhibition. The purpose of the exhibition is to enhance the visibility of student research and to assist in increasing awareness of its importance to the quality of undergraduate instruction. For a number of years, many of the college's upper division students have been conducting research under faculty mentors for class projects and papers. The poster exhibition allows the entire campus and community to view quality undergraduate student research.

Each division selects a faculty member to act as a jurist to review abstracts from the students within their division. Students whose abstracts are selected then develop a poster exhibition for late spring. The students display their posters and discuss their research projects with the entire community. The culminating activity features an invited speaker to address faculty, students, and others of the importance of research in higher education. Many of the research posters are developed from senior seminar capstone courses required in many of the College's programs.

RICHARD L. OSBURN and
JERRY W. VINCENT
Stephen F. Austin State University
Nacogdoches, Texas

As with many regional universities, the major obstacle to productive research efforts at Stephen F. Austin State University is a heavy teaching/service load. SFASU and the state of Texas recognize 12 semester hours as the normal load, with 9 semester hours as minimum. Though teaching credit is given for directing theses and dissertations, teaching graduate courses, teaching large sections (100+ students) and for special assignments (e.g. preprofessional advisor), the great majority of the faculty teach 9-12 semester hours. Proposals under consideration at SFASU that would assist in obtaining research opportunities for the faculty include: a) appointing a proposal/grant coordinator with a 3-hour course load reduction for each school, and b) permitting a 3-hour course load reduction for faculty who will prepare a major grant proposal. An additional idea being discussed includes use of the 9-hour course load minimum as a reward for productive faculty.

ROBERT L. CARET
Towson State University
Towson, Maryland

The Role of Faculty Development in the Research/ Instruction Partnership

Faculty development funding (both internal and external) can be directed and focused to strike an appropriate balance between the research/scholarship needs and teaching needs of the faculty. The balance between these two dimensions is constantly shifting as pressures and demands (again both internal and external) are placed on our institutions. It is vital that we, as administrators, plan an active role in deciding and effecting the appropriate balance for each of our institutions. This talk will focus on the Towson State University Faculty Development Program which has played a key role in allowing our institution to focus our energies and to maximize our strengths in both the areas of research and instruction.

PHILIP DUMAS and MICHAEL IANNONE
Trenton State College
Trenton, New Jersey

Although Trenton State College is predominately an undergraduate institution, research plays an integral role in the student's undergraduate experience.

The state of New Jersey, through a cooperative effort that involved the Governor, the Department of Higher Education, and the state colleges, has developed an innovative program that fosters the undergraduate research experience.

The Governor has initiated a challenge grant program. Under this program, state colleges in N.J. can apply for enhanced funding to support projects that foster excellence in undergraduate education. Trenton State College was the recipient of a grant which provided funds to establish distinguished research awards for faculty actively involved in undergraduate research. These funds provide released time and financial support for research.

A second program recently established by the N.J. Department of Higher Education also provides funding for undergraduate institutions to upgrade curriculum and to provide support for scientific instrumentation. Trenton State College has been very successful in obtaining grants under this program that have enabled the college to obtain state-of-the-art scientific equipment used in its undergraduate program. The college has received over a million dollars in such grants since 1984.

In addition, the administration of Trenton State College has established the Faculty Institutional Research and Sabbatical Leave Committee, which is an on-campus committee that solicits research grant applications, evaluates them, and grants released time and financial support to successful applicants.

The programs briefly described above have had a major impact on undergraduate research. Faculty in the sciences have received funding for their research in each of these programs.

RAJ M. KARIM
West Chester University
West Chester, Pennsylvania

West Chester University achieved university status in 1982. The sudden transition occurred without increased state appropriation and with virtually no external funding to support research.

To meet the challenge, the university now provides more than $70,000 annually in the form of faculty development or Research and Publication grants. These are used by recipients to purchase part-time release from teaching to pursue research. Several successful federal grant proposals have resulted from these activities.

The State System of Higher Education has recently allocated funds for competitive proposals in five areas: joint faculty-student research, applied research and public service, improvement of teaching and learning, curriculum development, and enhancement of institutional faculty development programs. Another state program encourages research cooperation between colleges and local industry, and provides a unique research opportunity for students.

Increased research activity has enhanced the curriculum in the natural sciences and has resulted in greater interaction with the broader academic community.

West Chester University is at the embryonic stage in solving problems relative to research/instructional partnership. Because of the nature of the institution, the basic problem is the time constraint to pursue research/scholarship. The university, through the Faculty Development Committee and the Research and Publication Committee, solicits applications and awards yearly a total of more than $70,000 for travel, publications, and research equipment, as well as 4-1/4 release time. Some of the release time and supportive resource awards are designated for new tenured faculty to pursue research leading to full length grant proposal to external agencies. Additionally, three partial summer salary awards have been instituted through the office of sponsored research for grant related activities by the Provost, and increased commitment for the summer 1988 was assured. Nearly half of the indirect cost money generated from the external grants is given to the specific department as added incentive. State System of Higher Education Faculty Professional Development Council, through a new initiative for faculty development, allocated money for competitive proposals in five areas: joint faculty-student research, applied research and public service improvement of teaching and learning, curriculum development, and enhancement of

institutional faculty development programs. The available sums of $100,000, $200,000 and $400,000 are to be allocated for the years 1987-88, 1988-89, and 1989-90, respectively.

The university has a formal agreement for Cooperative Teaching/Research Partnerships with Montpellier University, France, Bryn Mawr Hospital, Pennsylvania State University, Coatesville V.A. Medical Center, and a few industries in Pennsylvania.

The Dean of Graduate Studies and Sponsored Research visits with faculty and discusses the value of academic freedom through research/scholastic funding, and initiates grant proposals through his personal contact with faculty. Brainstorming sessions are a regular group event. The Dean and the staff of the Office of Sponsored Research provide research assistance, writing assistance, completion of budgets, word processing services, editing, maintenance and publication of bi-weekly current grant information, targeting and encouraging interested faculty to specific grants and personally writing grants. On occasion, the Sponsored Research Office hosts group meetings to work on cooperative grant proposals such as the successful "Pennsylvania Writing Project" and twenty-nine other awards, totaling $1,325,548 for 1986-87.

The President hosts a reception in his home yearly for all faculty members seeking external grants, and awards every funded first time investigator with a certificate, and an award to the member who received the maximum external funding for research/instruction partnership.

Special thanks to . . .

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The California State University (CSU) —

19 campuses, 342,667 students, 19,250 faculty — the largest system of senior higher education in the U.S., with students from all 50 states and 115 foreign nations. (Office of the Chancellor, 400 Golden Shore, Long Beach, California 90802-4275)

American Association of State Colleges and Universities (AASCU) —

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